

CHRISTMAN'S CP CHEMISTRY COMPANION

2013-2014

Periodic Table of The Elements

In the periodic table the elements are arranged in order of increasing atomic number. Vertical columns headed by Arabic numerals are called *Groups*. A horizontal sequence of elements is called a *Period*. The most active elements are at the top right and bottom left of the table. The staggered line (Groups 13-17) roughly separates metallic from non-metallic elements.

Groups—Elements within a group have similar properties and contain the same number of electrons in their outside energy shell.

—The first group (1) includes

hydrogen and the alkali metals.

—The last (18) contains the *inert*

gases.

—Group (17) includes the *halogens*.

—The elements intervening between

groups 2 and 13 are called

transition elements.

—Short vertical columns without

Arabic numeral headings are

called subgroups.

Periods—in a given period the properties of the elements gradually pass from a strong metallic to a strong non-metallic nature, with the last number of a period being an inert gas.

d ORBITALS FILLING

p ORBITALS FILLING NON-METALS

Hydrogen 1.0079 H 1	Lithium 6.941 Li 3	Beryllium 9.012 Be 4
Sodium 22.990 Na 11	Magnesium 24.305 Mg 12	
Potassium 39.098 K 19	Calcium 40.08 Ca 20	
Rubidium 85.47 Rb 37	Sr 87.62 Sr 38	
Cesium 132.90 Cs 55	Barium 137.33 Ba 56	
Francium (223) Fr 87	Radium (226) Ra 88	
Lanthanide Series 58 Ce	Praseodymium 140.91 Pr 59	Neodymium 144.24 Nd 60
Actinide Series 90 Th	Protactinium 231 Pa 91	Uranium 238.03 U 92

Scandium 44.956 Sc 21	Titanium 47.88 Ti 22	Vanadium 50.942 V 23	Chromium 51.996 Cr 24	Manganese 54.938 Mn 25	Iron 55.847 Fe 26	Cobalt 58.933 Co 27	Nickel 58.69 Ni 28	Copper 63.546 Cu 29	Zinc 65.39 Zn 30
Yttrium 88.906 Y 39	Zirconium 91.224 Zr 40	Niobium 92.906 Nb 41	Molybdenum 95.94 Mo 42	Technetium (98) Tc 43	Ruthenium 101.07 Ru 44	Rhodium 102.91 Rh 45	Palladium 106.42 Pd 46	Silver 107.87 Ag 47	Cadmium 112.41 Cd 48
Lanthanum 138.91 La 57	Hafnium 178.49 Hf 72	Tantalum 180.95 Ta 73	Tungsten 183.85 W 74	Rhenium 186.21 Re 75	Osmium 190.2 Os 76	Iridium 192.22 Ir 77	Platinum 195.08 Pt 78	Gold 196.97 Au 79	Mercury 200.59 Hg 80
Actinium (227) Ac 89	Ununquadium (261) Unq 104	Ununpentium (262) Unp 105	Ununhexium (263) Unh 106	Ununseptium (264) Uns 107	Ununoctium (265) Uno 108	Ununennium (266) Une 109	Unbinilium (267) Uun 110	Untrium Uuu 111	Unquadrium Uub 112

Boron 10.811 B 5	Carbon 12.011 C 6	Nitrogen 14.007 N 7	Oxygen 15.999 O 8	Fluorine 18.998 F 9	Helium 4.003 He 2
Aluminum 26.982 Al 13	Silicon 28.086 Si 14	Phosphorus 30.974 P 15	Sulfur 32.066 S 16	Chlorine 35.453 Cl 17	Argon 39.948 Ar 18
Gallium 69.723 Ga 31	Germanium 72.61 Ge 32	Arsenic 74.922 As 33	Selenium 78.96 Se 34	Bromine 79.904 Br 35	Krypton 83.80 Kr 36
Indium 114.82 In 49	Tin 118.71 Sn 50	Antimony 121.75 Sb 51	Tellurium 127.60 Te 52	Iodine 126.90 I 53	Xenon 131.29 Xe 54
Thallium 204.38 Tl 81	Lead 207.2 Pb 82	Bismuth 208.98 Bi 83	Polonium (209) Po 84	Astatine (210) At 85	Radon (222) Rn 86
Ununquadium Uuq 114	Unquadium Uut 113	Unquadium Uub 112	Unquadium Uuu 111	Unquadium Uuu 110	Unquadium Uuu 109

forbitals

Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning. **Albert Einstein**



Electron Filling	VSEPR THEORY Molecular Geometry	MOLE MAP	GAS LAWS
1s 2s 2p 3s 3p 3d 4s 4p 4d 4f 5s 5p 5d 5f 6s 6p 6d 7s 7p	AX ₂ Linear AX ₃ Trigonal Planar AX ₂ E Bent AX ₄ Tetrahedral AX ₃ E Trigonal Pyramidal AX ₂ E ₂ Bent	Grams ↔ Moles ↔ Atoms or Molecules Molar Mass (g/mol) Avogadro's # (6.022 x 10 ²³)	Boyles Law: P ₁ V ₁ = P ₂ V ₂ Charles Law: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ Combined Law: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ Ideal Gas Law: PV=nRT R = 0.0821 L-atm/mol-K STP: Pressure: 1.00 atm Temp: 273 K d = $\frac{mmP}{RT}$ mm = $\frac{gRT}{PV}$ Pressure Conversions 1.00atm = 760mmHg = 760torr = 101.3 kPa

<div><div>Metric English Equivalents (length)</div><div>1.000 mi = 5280 ft 1.000 in = 2.540 cm 1.000 ft = 30.48 cm 1.000 yd = 0.9144 m 1.000 mi = 1.609 km 1A = 10⁻¹⁰ m = 0.1nm 1.000 cm = 0.3937 in 1.000 m = 39.37 in 1.000 m = 1.094 yd</div></div>	<div><div>Metric English Equivalents (mass)</div><div>1 lb = 16 oz 1.000 oz = 28.23 g 1.000 lb = 453.6 g 1.000 lb = 0.4536 kg 1 metric ton = 1000 kg 1.000 g = 0.03527 oz 1.000 kg = 35.27 oz 1.000 kg = 2.205 lb</div></div>	<div><div>Metric English Equivalents (volume)</div><div>1.000 cm³ = 1.000 mL 1000 cm³ = 1.000 L 1ft³ = 1728 in³ 1 yd³ = 27 ft³ 1 yd³ = 46656 in³ 1.000 in³ = 16.39 cm³ 1.000 ft³ = 28.32 dm³ 1.000 dm³ = 1.000 L 1.000 cm³ = 0.06102 in³</div></div>	<div><div>TEMP. CONVERSIONS</div><div>°C = °F – 32 F = (1.8)°C + 32 1.8 K = °C + 273</div></div>	<div><div>CONVERSIONS</div><div>1.0 in = 2.54 cm 1.0 lb = 454 g 1.0 qt = 0.9463 L 1.0 km = 0.6214 mi 1 cal = 4.184 J 1 gal = 4 qt 1 atm = 760 mmHg</div></div>	<div><div>SYSTEM INTERNATIONAL PREFIXES (SI)</div><table><tr><th>Prefix</th><th>abbr.</th><th>Means</th><th>Multiplier</th></tr><tr><td>tera</td><td>T</td><td>Trillion</td><td>10¹²</td></tr><tr><td>giga</td><td>G</td><td>billion</td><td>10⁹</td></tr><tr><td>mega</td><td>M</td><td>million</td><td>10⁶</td></tr><tr><td>kilo</td><td>k</td><td>thousand</td><td>10³</td></tr><tr><td>hecto</td><td>h</td><td>hundred</td><td>10²</td></tr><tr><td>deca</td><td>da</td><td>ten</td><td>10¹</td></tr><tr><td>-----</td><td>--</td><td>base unit</td><td>10⁰</td></tr><tr><td>deci</td><td>d</td><td>1 tenth</td><td>10⁻¹</td></tr><tr><td>centi</td><td>c</td><td>1 hundredth</td><td>10⁻²</td></tr><tr><td>milli</td><td>m</td><td>1 thousandth</td><td>10⁻³</td></tr><tr><td>micro</td><td>μ</td><td>1 millionth</td><td>10⁻⁶</td></tr><tr><td>nano</td><td>n</td><td>1 billionth</td><td>10⁻⁹</td></tr><tr><td>pico</td><td>p</td><td>1 trillionth</td><td>10⁻¹²</td></tr></table><div>*replace prefix with multiplier. Ex: 5.92μg = 5.92 x 10⁻⁶ g</div></div>	Prefix	abbr.	Means	Multiplier	tera	T	Trillion	10 ¹²	giga	G	billion	10 ⁹	mega	M	million	10 ⁶	kilo	k	thousand	10 ³	hecto	h	hundred	10 ²	deca	da	ten	10 ¹	-----	--	base unit	10 ⁰	deci	d	1 tenth	10 ⁻¹	centi	c	1 hundredth	10 ⁻²	milli	m	1 thousandth	10 ⁻³	micro	μ	1 millionth	10 ⁻⁶	nano	n	1 billionth	10 ⁻⁹	pico	p	1 trillionth	10 ⁻¹²	<div><div>SI BASE UNITS</div><table><tr><th>Quantity</th><th>Unit</th><th>abby</th></tr><tr><td>Length</td><td>meter</td><td>m</td></tr><tr><td>Mass</td><td>kilogram</td><td>kg</td></tr><tr><td>Time</td><td>second</td><td>s</td></tr><tr><td>Amt.</td><td>mole</td><td>mol</td></tr><tr><td>Tem</td><td>Kelvin</td><td>K</td></tr><tr><td>Electric</td><td>ampere</td><td>A</td></tr></table></div>	Quantity	Unit	abby	Length	meter	m	Mass	kilogram	kg	Time	second	s	Amt.	mole	mol	Tem	Kelvin	K	Electric	ampere	A										
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<div><div>ACIDS AND BASES</div><div>pH = -log [H₃O⁺] & pOH = -log [OH⁻] pH + pOH = 14.00 <div>pH SCALE</div><div>Stronger Acid ← 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 → Stronger Base</div><div>7 = neutral pH</div><div>Kw = [H₃O⁺] [OH⁻] = 1.00 x 10⁻¹⁴</div><div>Ka = x²/(a-x) x = [H₃O⁺]</div><div>Kb = x²/(a-x) x = [OH⁻]</div></div></div>	<div><div>STRONG BASES</div><div>Group IA and IIA Hydroxides (except for beryllium and magnesium hydroxide)</div></div>	<div><div>TEMP. CONVERSIONS</div><div>°C = °F – 32 F = (1.8)°C + 32 1.8 K = °C + 273</div></div>	<div><div>MOLE CONCEPT</div><div>Avogadros # = 6.022 x 10²³ 1 MOLE = atomic mass in grams of an element = formula mass in grams for a compound = 6.022 x 10²³ atoms of an element = 6.022 x 10²³ formula units of a compound = 22.4 L of a gas at STP</div></div>	<div><div>DIATOMIC ELEMENTS (HOFBrINCl)</div><div>Hydrogen Oxygen Fluorine Bromine Iodine Nitrogen Chlorine</div></div>	<div><div>COMMON POLYATOMIC IONS</div><table><tr><th>FORMULA</th><th>NAME</th><th>FORMULA</th><th>NAME</th></tr><tr><td>C₂H₃O₂⁻</td><td>acetate (or CH₃COO⁻)</td><td>OH⁻</td><td>hydroxide</td></tr><tr><td>NH₂⁻</td><td>amide</td><td>BrO⁻</td><td>hypobromite</td></tr><tr><td>AsO₄³⁻</td><td>arsenate</td><td>ClO⁻</td><td>hypochlorite</td></tr><tr><td>BO₃³⁻</td><td>borate</td><td>IO⁻</td><td>hypoiodite</td></tr><tr><td>BrO₃⁻</td><td>bromate</td><td>IO₃⁻</td><td>iodate</td></tr><tr><td>CO₃²⁻</td><td>carbonate</td><td>C₂O₄²⁻</td><td>oxalate</td></tr><tr><td>ClO₂⁻</td><td>chlorite</td><td>NO₂⁻</td><td>nitrite</td></tr><tr><td>CrO₄²⁻</td><td>chromate</td><td>NO₃⁻</td><td>nitrate</td></tr><tr><td>ClO₃⁻</td><td>chlorate</td><td>ClO₄⁻</td><td>perchlorate</td></tr><tr><td>CN⁻</td><td>cyanide</td><td>IO₄⁻</td><td>periodate</td></tr><tr><td>Cr₂O₇²⁻</td><td>dichromate</td><td>MnO₄⁻</td><td>permanganate</td></tr><tr><td>H₂PO₄⁻</td><td>dihydrogen phosphate</td><td>O₂²⁻</td><td>peroxide</td></tr><tr><td>SiF₆²⁻</td><td>hexafluorosilicate</td><td>PO₄³⁻</td><td>phosphate</td></tr><tr><td>HCO₃⁻</td><td>hydrogen carbonate (bicarbonate)</td><td>PO₃³⁻</td><td>phosphite</td></tr><tr><td>HC₂O₄⁻</td><td>hydrogen oxalate (binoxalate)</td><td>SeO₄²⁻</td><td>selenate</td></tr><tr><td>HPO₄²⁻</td><td>hydrogen phosphate</td><td>SiO₃²⁻</td><td>silicate</td></tr><tr><td>HSO₄⁻</td><td>hydrogen sulfate (bisulfate)</td><td>SO₄²⁻</td><td>sulfate</td></tr><tr><td>HS⁻</td><td>hydrogen sulfide</td><td>SO₃²⁻</td><td>sulfite</td></tr><tr><td>HSO₃⁻</td><td>hydrogen sulfite (bisulfite)</td><td>C₄H₄O₆²⁻</td><td>tartrate</td></tr><tr><td></td><td></td><td>B₄O₇²⁻</td><td>tetraborate</td></tr><tr><td></td><td></td><td>S₂O₃²⁻</td><td>thiosulfate</td></tr></table></div>	FORMULA	NAME	FORMULA	NAME	C ₂ H ₃ O ₂ ⁻	acetate (or CH ₃ COO ⁻)	OH ⁻	hydroxide	NH ₂ ⁻	amide	BrO ⁻	hypobromite	AsO ₄ ³⁻	arsenate	ClO ⁻	hypochlorite	BO ₃ ³⁻	borate	IO ⁻	hypoiodite	BrO ₃ ⁻	bromate	IO ₃ ⁻	iodate	CO ₃ ²⁻	carbonate	C ₂ O ₄ ²⁻	oxalate	ClO ₂ ⁻	chlorite	NO ₂ ⁻	nitrite	CrO ₄ ²⁻	chromate	NO ₃ ⁻	nitrate	ClO ₃ ⁻	chlorate	ClO ₄ ⁻	perchlorate	CN ⁻	cyanide	IO ₄ ⁻	periodate	Cr ₂ O ₇ ²⁻	dichromate	MnO ₄ ⁻	permanganate	H ₂ PO ₄ ⁻	dihydrogen phosphate	O ₂ ²⁻	peroxide	SiF ₆ ²⁻	hexafluorosilicate	PO ₄ ³⁻	phosphate	HCO ₃ ⁻	hydrogen carbonate (bicarbonate)	PO ₃ ³⁻	phosphite	HC ₂ O ₄ ⁻	hydrogen oxalate (binoxalate)	SeO ₄ ²⁻	selenate	HPO ₄ ²⁻	hydrogen phosphate	SiO ₃ ²⁻	silicate	HSO ₄ ⁻	hydrogen sulfate (bisulfate)	SO ₄ ²⁻	sulfate	HS ⁻	hydrogen sulfide	SO ₃ ²⁻	sulfite	HSO ₃ ⁻	hydrogen sulfite (bisulfite)	C ₄ H ₄ O ₆ ²⁻	tartrate			B ₄ O ₇ ²⁻	tetraborate			S ₂ O ₃ ²⁻	thiosulfate
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<div><div>STRONG ACIDS</div><div>Sulfuric Acid H₂SO₄ Nitric Acid HNO₃ Hydrochloric Acid HCl Perchloric Acid HClO₄ Hydroiodic Acid HI Hydrobromic Acid HBr</div></div>	<div><div>THERMOCHEMISTRY</div><div>ΔH = H (products) – H (reactants) C = q/ΔT , ΔT = T_{final} – T_{initial} s = q / m ΔT ΔH > 0 Endo ΔH<0 Exo q= s x m x ΔT Standard State –1 atm pressure and 25°C. ΔH° = Σ n ΔH°_f (products) - Σ m ΔH°_f (reactants)</div></div>	<div><div>DIATOMIC ELEMENTS (HOFBrINCl)</div><div>Hydrogen Oxygen Fluorine Bromine Iodine Nitrogen Chlorine</div></div>	<div><div>COMMON POLYATOMIC IONS</div><table><tr><th>FORMULA</th><th>NAME</th><th>FORMULA</th><th>NAME</th></tr><tr><td>C₂H₃O₂⁻</td><td>acetate (or CH₃COO⁻)</td><td>OH⁻</td><td>hydroxide</td></tr><tr><td>NH₂⁻</td><td>amide</td><td>BrO⁻</td><td>hypobromite</td></tr><tr><td>AsO₄³⁻</td><td>arsenate</td><td>ClO⁻</td><td>hypochlorite</td></tr><tr><td>BO₃³⁻</td><td>borate</td><td>IO⁻</td><td>hypoiodite</td></tr><tr><td>BrO₃⁻</td><td>bromate</td><td>IO₃⁻</td><td>iodate</td></tr><tr><td>CO₃²⁻</td><td>carbonate</td><td>C₂O₄²⁻</td><td>oxalate</td></tr><tr><td>ClO₂⁻</td><td>chlorite</td><td>NO₂⁻</td><td>nitrite</td></tr><tr><td>CrO₄²⁻</td><td>chromate</td><td>NO₃⁻</td><td>nitrate</td></tr><tr><td>ClO₃⁻</td><td>chlorate</td><td>ClO₄⁻</td><td>perchlorate</td></tr><tr><td>CN⁻</td><td>cyanide</td><td>IO₄⁻</td><td>periodate</td></tr><tr><td>Cr₂O₇²⁻</td><td>dichromate</td><td>MnO₄⁻</td><td>permanganate</td></tr><tr><td>H₂PO₄⁻</td><td>dihydrogen phosphate</td><td>O₂²⁻</td><td>peroxide</td></tr><tr><td>SiF₆²⁻</td><td>hexafluorosilicate</td><td>PO₄³⁻</td><td>phosphate</td></tr><tr><td>HCO₃⁻</td><td>hydrogen carbonate (bicarbonate)</td><td>PO₃³⁻</td><td>phosphite</td></tr><tr><td>HC₂O₄⁻</td><td>hydrogen oxalate (binoxalate)</td><td>SeO₄²⁻</td><td>selenate</td></tr><tr><td>HPO₄²⁻</td><td>hydrogen phosphate</td><td>SiO₃²⁻</td><td>silicate</td></tr><tr><td>HSO₄⁻</td><td>hydrogen sulfate (bisulfate)</td><td>SO₄²⁻</td><td>sulfate</td></tr><tr><td>HS⁻</td><td>hydrogen sulfide</td><td>SO₃²⁻</td><td>sulfite</td></tr><tr><td>HSO₃⁻</td><td>hydrogen sulfite (bisulfite)</td><td>C₄H₄O₆²⁻</td><td>tartrate</td></tr><tr><td></td><td></td><td>B₄O₇²⁻</td><td>tetraborate</td></tr><tr><td></td><td></td><td>S₂O₃²⁻</td><td>thiosulfate</td></tr></table></div>	FORMULA	NAME	FORMULA	NAME	C ₂ H ₃ O ₂ ⁻	acetate (or CH ₃ COO ⁻)	OH ⁻	hydroxide	NH ₂ ⁻	amide	BrO ⁻	hypobromite	AsO ₄ ³⁻	arsenate	ClO ⁻	hypochlorite	BO ₃ ³⁻	borate	IO ⁻	hypoiodite	BrO ₃ ⁻	bromate	IO ₃ ⁻	iodate	CO ₃ ²⁻	carbonate	C ₂ O ₄ ²⁻	oxalate	ClO ₂ ⁻	chlorite	NO ₂ ⁻	nitrite	CrO ₄ ²⁻	chromate	NO ₃ ⁻	nitrate	ClO ₃ ⁻	chlorate	ClO ₄ ⁻	perchlorate	CN ⁻	cyanide	IO ₄ ⁻	periodate	Cr ₂ O ₇ ²⁻	dichromate	MnO ₄ ⁻	permanganate	H ₂ PO ₄ ⁻	dihydrogen phosphate	O ₂ ²⁻	peroxide	SiF ₆ ²⁻	hexafluorosilicate	PO ₄ ³⁻	phosphate	HCO ₃ ⁻	hydrogen carbonate (bicarbonate)	PO ₃ ³⁻	phosphite	HC ₂ O ₄ ⁻	hydrogen oxalate (binoxalate)	SeO ₄ ²⁻	selenate	HPO ₄ ²⁻	hydrogen phosphate	SiO ₃ ²⁻	silicate	HSO ₄ ⁻	hydrogen sulfate (bisulfate)	SO ₄ ²⁻	sulfate	HS ⁻	hydrogen sulfide	SO ₃ ²⁻	sulfite	HSO ₃ ⁻	hydrogen sulfite (bisulfite)	C ₄ H ₄ O ₆ ²⁻	tartrate			B ₄ O ₇ ²⁻	tetraborate			S ₂ O ₃ ²⁻	thiosulfate		
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